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THE PEARL FISHERY OF VENEZUELA

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INTRODUCTION

At the invitation of the Venezuelan Government the author had an opportunity to visit in March-April 1948 the principal pearl oyster grounds in the vicinity of Margarita Island. During this trip it was possible to inspect in detail the methods of fishing, to observe the appraisal and sale of pearls in Porlamar, and to obtain an understanding of the very efficient system of government management of the fishery by the Ministerio de Agricultura y Cría. The accomplishment of this task in a relatively short time was possible only through very friendly and effective cooperation by the Sr. Ricardo Montilla, Ministro de Agricultura y Cría in Caracas. Mr. Robert O. Smith of the Fish and Wildlife Service, United States Department of the Interior, serving as Chief of the United States Fishery Mission to Venezuela, made travel arrangements, arranged for the cooperation of Venezuelan agencies, and otherwise rendered valuable assistance. Sr. Julian Verois L., Jefe de Sección de Pesqueria de la Ministerio de Agricultura y Cría, Sr. Jose Maria Velásquez, Encargado de la Jefatura de la Zona Pesquera de Oriente y Cap. José M. Mosqueira Manso, del Cuerpo General de Servicios Marítimos, provided all the necessary facilities for field work, gave detailed information regarding the various aspects of the pearl industry and the biology of the pearl oyster and, through their kind hospitality, made my sojourn in Venezuela both profitable and pleasant. It is my privilege to acknowledge here my indebtedness and express my thanks to all these gentlemen for their kind efforts and many courtesies.

BRIEF HISTORY OF THE PEARL FISHERY

The Atlantic pearl oyster, Pinctada margaritifera, found in several places along the coast of Venezuela, is especially abundant around the islands of Margarita, Cubagua, and Coché, located from 10 to 15 miles off the mainland. The area of distribution of this species extends over the entire Caribbean Sea, but only in a few locations is the population of pearl oysters dense enough for commercial exploitation.

Long before the discovery of the New World, pearls were known to the Indians of Central and South America. In many instances the Spaniards, who first landed on the islands and on the mainland of South and Central America, found the savages wearing necklaces and bracelets studded with pearls. Archaelogical explorations show that pearls were in vogue among the civilized peoples of Mexico and Peru, who used them to adorn their garments. It is doubtful, however, that organized pearl fishery existed in these countries during the pre-Columbian time. So far as I know, no large accumulation of pearl oyster shells has been found in shell deposits of the ancient time. For instance, the excavations made on Margarita Island (De Booy, 1916) show that the largest shell deposits near the village of San José de Paraguschi, known as Giri-Giri, consist of various species of local mollusks, such as Mytilus achatinus, Tivela mactroides, Fissuridea virescens, Murex rosarium, Purpura floridana, P. patula, P. haemastoma, Fasciolaria tulipa, Strombus gigas, Cypraea exanthema, Livona pica, and others. The deposit contains, also, a number of fragments of human bones, split as if to extract the marrow, occasional shards and other artefacts, but the shells of the pearl oysters which abound in the waters around the island are absent.

There is no evidence that any pearls were discovered by Columbus during his first and second voyages, but his interest in pearls undoubtedly existed, even when he first conceived the plan of his expedition. In the contract granted by the rulers of Spain on April 17, 1492, Columbus was given "right to keep for himself one-tenth of all the pearls, precious stones, gold, silver, spices, etc." (Mosk, 1938). It appears significant that among different valuables the pearls are listed in the first place.

On the third voyage, after touching the northern coast of South America at the Gulf of Paria, Columbus sailed west, and on July 31, 1489 passed the three islands and, strangely enough, named the largest of them "Margarita," which, in Spanish, signifies "pearl." According to Gonzalo de Oviedo (1535), Columbus was not aware at this time that waters around Margarita abounded in pearls. The next day, an Indian who was found in possession of pearls, created great excitement and a search for pearls that ensued resulted in the accumulation by the crew of six marks (48 ounces) of assorted pearls which were obtained in exchange for buttons, needles, scissors, and fragments of earthenware. The small island between Margarita and the mainland, later known as Cubagua, was called by

Columbus "Isla de Perlas." Upon returning to Spain, Columbus tried to keep secret the source of the newly discovered wealth, but the pearls displayed by his sailors aroused such great interest that several groups were immediately organized and departed to America. One of the pearl-trading ventures was organized by Luis Guerra, who placed in charge of the expedition an adventurer by the name of Peralonso Niño. His expedition was a success. According to Gomara (1749), Niño brought back 96 pounds of pearls, among them were many gems of five and more carats. A more conservative estimate is given, however, by Oviedo, who states Niño's lot consisted of 50 marks (400 ounces or 25 pounds), and that no pearl weighed more than five carats, although many of them were of excellent shape and lustre. Unfortunately for Niño, upon his return early in 1501 he quarreled with his men, was imprisoned, and his pearls and vessels were confiscated.

The second expedition, headed by Luis Guerra himself, soon reached Margarita for the purpose of trading with Indians. It yielded nearly a "costal" (sackful) of pearls but the vessel containing the treasure was wrecked. Trading in pearls soon led to a more profitable business of pearl fishing, and establishment of permanent settlements in the vicinity of pearl oyster grounds. About 1500, fifty adventurers sailed from Hispaniola and founded the first settlement on Cubagua for the purpose of exploiting the pearl fishery (Dalton, 1912). This settlement, known as Nueva Cadiz, was apparently a success, for in 1521 it was granted by the Crown the privilege of self-government.

At the beginning of the exploitation of pearl grounds, natives were employed as divers. The practice was soon discontinued, and instead of using local labor, the Spaniards began to import Lucayan Indians from the Bahamas, who were particularly skillful in diving.

Pearl fishing must have been at that time a very lucrative business, as the Spaniards sometimes paid as much as 150 ducats each for a skillful diver.

The description of the method of fishing used at this time at Cubagua is given by Oviedo (l.c.). Usually seven divers were sent out in a small boat under the supervision of an overseer. Each diver had a net tied to his waist or neck, in which he placed oysters. To expedite his descent, the diver weighed himself down with heavy rocks. The net was emptied after each dive, while the diver rested on deck. After a sufficient supply had been gathered, oysters were stored ashore in sheds, then, under the watchful eyes of supervisors, were opened and the pearls collected and sorted. Indian slave divers were treated harshly. They were permitted but very short respite between the dives, worked long hours, and consequently suffered hemorrhages and intestinal disorders. Many were killed by sharks. To replenish the supply of divers, systematic raids were made on the neighboring islands and coast. According to Las Casas (16th Cent., ed. 1875), this practice and cruel treatment of divers proved as destructive to human life as were the infamous mines of Espanola and Cuba.

The difficulties in obtaining Indian divers gradually increased. Some of the tribes, like those of Margarita Island, determined and skillful enough in defending themselves with weapons, successfully resisted capture and eventually were left alone. Others moved to the interior and consequently the local supply of available slave labor was exhausted. Gradually the Indian divers were replaced by Negroes. Royal Decree of June 25, 1558 definitely prohibited the use of Indians in pearl fishing and prescribed that only Negroes be used for this purpose.

So intensive was the fishing that signs of depletion of pearl oyster grounds became noticeable early in the 16th Century, and toward the end of the century shallow grounds were stripped clear of oysters, while deeper banks could not be worked with naked divers. Oviedo writes that through experience the organizers of pearl fishing expeditions were aware of the fact that an exhausted oyster bed would restore itself if not exploited for a time. He adds, rather pathetically, that "even though this be the case, the Christians have been so hasty to search for these pearls that they have not contented themselves with divers in getting them; they have discovered other devices, such as rakes and nets, and they have extracted such a quantity that scarcity began to set in and they are no longer found in abundance, as at first " (Oviedo, l. c. I, 608, quoted from Mosk). It is of interest that in 1583 a Sicilean inventor, Guiseppe Bruno, submitted to the Spanish Government a sketch of a diving bell which he intended to employ for gathering pearl oysters. He tried to obtain official authorization of his venture but apparently without success

since in the "Expediente de la Archivo General de Indias" in Sevilla, where his sketch can be found, nothing is shown that the license for this invention was granted.

The exact number of Indian or Negro divers employed by Spaniards is not know. It is reasonable to expect, however, that it was quite large, probably not less than several hundred. In 1621, when only 130 Negro divers were left on Margarita, it was recommended that 300 slaves be imported to revive the pearl fishery.

After a period of rapid exploitation following Columbus' discovery of the New World, the pearl fishery along the northern coast of South America continued on a gradually diminishing scale, and completely ceased by the end of the 17th Century. Severe and probably final blows were dealt by frequent pirate raids, which completely ruined the pearl fisheries of Margarita, Cubagua, and Coché.

It would be, of course, of great interest to obtain some records of the value of pearls taken at this time from Venezuelan pearl oyster grounds. Although no satisfactory records of pearl trade are available, some idea of the relative importance and value of pearl fishery to Spanish treasure in the 16th Century can be gained from the data assembled by Alexander v. Humboldt (1819-1829, II p. 273). In his travels in Venezuela, Humboldt, with his indefatigable energy, was able to gather old records of the number and value of pearls shipped from South America to Spain. Since the King's treasury collected "one-fifth" of the pearls found in these waters, the shipments were very carefully recorded and entered in Treasury's book. From this source we learn that in the earlier years of the 16th Century up to 1530, the value of pearls sent to Europe averaged more than 800,000 piastres (pesos) annually. It is interesting to note that at that time the value of all the products mined every year in America and exported to Europe did not exceed 2,000,000 pesos.

The richness of the pearl grounds off the Venezuelan coast can be judged by the following records: In one month of January 1529 more than 1,500 marks (12,000 ounces) of pearls, or the equivalent of over 17 million carats,[1/] were taken from the pearl beds of the Island of Coché. This quantity far exceeds the best annual catch of the present years. Further information may be obtained from a study of the accounts of shipments made by the officials of the Royal Treasury at Hispanola to the Casa Contratación in Spain—a special agency set up by the government to collect the tax on gold, pearls, precious stones and other goods brought from America (Haring, 1918). For instance, on January 24, 1533, the Captain of the Vessel Trinidad received from the royal officials at Cubagua several boxes of pearls, one of them containing 90 pearls of good size, and the others holding more than 10 marks of rough pearls. Other shipments contained large number of pearls. The "Nicolas," which sailed for Spain in June 1533, carried more than 200 marks (1,600 ounces) of pearls. In July 1534, the Captain of the Santa Maria de Begonia received for shipment two boxes of pearls from Cubagua, one containing 200 marks (1,600 ounces) of "common" pearls, while another contained 1,000 marks (8,000 ounces) of small pearls.

Other records refer to the shipments, varying from 93 to 140 marks, of pearls made in June 1535 and June 1536. In 1538, the squadron, under the command of Blasco Nuñez de Vela, transported pearls valued at 208 ducats. The largest shipment, worth 9,000 ducats, was made in 1543.

Oviedo stated (l. c. lib. XIX, caps 28, quoted from Haring, 1918) that the royal "quinto" or one-fifth from the pearl fisheries amounted to 15,000 ducats and more a year. He himself possessed a round pearl weighing 26 carats and secured another one in 1529 which he sold for 450 "pesos de oro."

A pear-shaped pearl from Darien, Panama, weighing 31 carats and of very fine color was sold in 1515 for 1,200 pesos and later found its way into the possession of the Queen. These scattered records give some idea of the value of pearls during the first half of the 16th Century.

1/ metric carat = 0.2 gram; one avoirdupois ounce = 141.747 carats

The largest and best pearls came, however, not from the Atlantic Coast but from the Pacific Islands off the coast of Panama. Pearls from the Caribbean Sea were relatively small, weighing at most from 2 to 5 carats. They were found, however, in greater quantities and Cubagua pearls were well known at Sevilla, Toledo, at the great fairs of Augsburg and Burges, and throughout Italy.

Pearl fishing continued on a very small scale until the end of the 17th Century, when it practically ceased in 1683. Laet (quoted from Humboldt, l.c.) described this decline in the following words: "Insularum Cubaguae et Coches quondam magna fuit dignitas, quum unionum captura floreret: nunc, illa deficiente, obscuram admodum fama."

Discussing the ill effects of overfishing, Humboldt mentions that pearl oyster or the "pearla ronde" as he calls it, is "of much more delicate constitution than the greater part of the other acephalous molluscae" and therefore cannot be transplated. He states that pearl oysters became scarce because their propagation had been prevented "from the imprudent destruction of the shells by the thousands" and not "as it is believed from a popular tradition, because these animals, frightened by the noise of the oars, conveyed themselves elsewhere" (Humboldt, 1799-1804, Vol. II). In support of his reference to overfishing, Humboldt wrote as follows: "To form an idea of the destruction of the species caused by divers, we must remember that a boat sometimes collects in two or three weeks more than 35,000 oysters. The animal lives but nine to ten years and it is only in its fourth year that the pearls begin to show themselves. In ten thousand shells there is often not a single pearl of value."

Other factors besides depletion contributed to the downfall of the Venezuelan pearl fishery in the 17th Century. The most important ones were the development of mining in Mexico and Peru which attracted capital and adventurers; pirate raids on the islands of Margarita, Cubagua, and Coché; discovery of rich pearl grounds on the west coast of Panama, and in California, and decrease in value of pearls on the European market caused by the manufacture of good artificial pearls in Venice and change in fashion due to the greater demand for cut diamonds. Although the cutting of diamonds was invented in the middle of the the 15th Century, the gems became popular only in the following century.

When Humboldt visited Venezuela about the beginning of the 19th Century, he found that "on the shoals that surround Cubagua, Coché, and Island of Margarita the pearl fishery is as much neglected as on the coast of California." In 1812, according to his observations, some attempts were made to resume pearl fishing at Margarita but the pearls that were found were small and had little brilliancy. Humboldt speculates that this may have been due to the changes in marine environment caused by earthquakes. He remarked also that it is believed at Cumaria that the pearl oysters have greatly multiplied after two centuries of repose. Depletion of pearl grounds and scarcity of divers were the principal factors in the decline of the pearl fisheries, which, in the 17th Century lost its former importance. According to Landaeta Rosales (1889) no significant pearl fishery was conducted until 1828, when an English businessman secured from the government of Colombia a fishing monopoly along the shores and islands of Margarita. He imported small hand dredges of the type used in the Mediterranean, and locally known as "Arrastra." Apparently the results of pearl fishing were insignificant. For the period from 1833 to 1845 the yield of pearls was so low that no tax, which at that time was rather heavy, was collected by the provincial government. The values varied from 150 to 500 bolivars per ounce of best quality pearls, to 80-100 bolivars for poorer lots (Quievreux, 1900). Another interruption in exploitation occurred shortly after 1850. At this time a new tax was imposed of 16 bolivars per boat per month. In 1853, this source of revenue gave only 48 bolivars. From 1854 to 1857, a pearl fishery was conducted by a merchant from Hamburg, Germany. The undertaking was discontinued in 1857; the annual yield amounted to only 400 ounces, a quantity not sufficient to cover the operating expenses.

According to Quievreux (1900) there was no regular exploitation between 1857 and 1895. During the latter year, the use of scaphander was tried near Margarita by a Frenchman, H. Boisselier. According to the article which appeared in Primer Annuario Estadistico de Venezuela for 1877, p. 201, the average annual yield of pearls in 1845 and for several following years was 1,600 ounces. The value of the best pearls varied from 40 to 100 venozalanos, and pearls of inferior quality were sold at 16 to 20 venozalanos per ounce. In 1857, the yield was only 400 ounces. There was apparently a revival of pearl fishing

toward the end of the nineteenth century, when 300 boats with 5 to 6 men in each, were operating from the bases at Juan Griego, Porlamar, Cumana, and Carupano. Oysters were gathered by skin divers and by dredges which the fishermen preferred to scaphanders. They believed that by dredging the oysters were spread over the bottom and the area of pearl bank was thus enlarged, while scaphander diving was destructive.

In 1899 there were seven pearl buyers operating at Porlamar. Pearls were exported primarily to Paris. The value of the catch was about two million French francs.

In 1900, exclusive rights for pearl fishing around Margarita and adjacent islands were granted for 25 years to Sebastian Cipriani (Gaceta Oficial, July 30, 1900, No. 7990 Ministerio de Fomento). The monopoly, which included also sponges and other products, exclusive of fish, gave permission to the contractor to use underwater gear. Local fishermen were guaranteed the right to use their own methods of fishing. Contractor had to pay 10 percent net of the proceeds of fishery but was free of other tax.

The state of pearl fishery in more recent years may be judged from the official statistical data (Table 1) which I was able to obtain from the office of the Sección de Pesqueria, Ministerio de Agricultura y Cría, and from official publications available in the Library of Congress in Washington and the Pan American Union.

Table 1 — Production of Pearl Oysters in Venezuela from 1919 to 1947

Year	Carat	Values in bolivars	Source of information
1919		429,403 1/	Velos Goiticoa, 1924
1921-22		313,000 1/	do.
1932	2,185,505	1,743,212	Memoria y Cuenta de Agricultura y Cría, Toma 1 - 1944
1934	517,172	680,147	do.
1937	418,207	481,181	do.
1940	1,369,874	879,172	do.
1943	4,998,257	2,368,656	do.
1945	1,400,214	1,050,160	Memoria, Ministerio de Agricultura y Cría, 1948
1946	1,281,899	1,666,468	do.
1947	1,784,857	4,164,919	do.

1/ According to Lopez (1940) total yield of pearls during the 19-year period from 1921 to 1940 was 7,069,630 carats, valued at 18,386,377 bolivars.

It is clear from this brief and incomplete historical sketch that from the very beginning of exploitation up to present the pearl fishery was subject to wide fluctuations. Years of high yield were followed by protracted periods of relative inactivity, presumably because of the exhaustion of pearl grounds and scarcity of divers.

It is interesting that the necessity of protecting the pearl resources and preserving the life of divers was recognized even in the olden times. During the rule of Charles V, a Royal Decree was issued by the Government of Spain which limited the pearl fishing to the summer months. Several humanitarian measures issued at the same time limited the work of divers to 4 hours a day, at a depth not exceeding 8 fathoms. The decree forbade the owners of slave divers to force them to work more than 4 hours a day at the depth from 5 to 8 fathoms. It was prohibited to demand them to perform other work. The decree also specified that the divers should receive good food and a pint of wine a day, and be provided with clothing and hammocks for sleeping. Another decree forbade, under penalty of death, to force a free person to dive for pearls. These well-meaning but illusory measures remained on paper only since not the slightest attempt was made to enforce them.

Exhaustion of pearl grounds below the point of profitable exploitation acted as a conservation measure. The oyster banks were left undisturbed for indefinite periods, and the exhausted population of oysters gradually recovered by natural propagation. The same principle of conservation is being used at present. As one can see from table 1, from 1932 to 1945 pearl fishery was conducted at intervals of 2 or 3 years to permit the recovery of pearl grounds. By decreasing the season from 6 to 4 months (in 1945) it was possible to carry out pearl fishing operations for 3 consecutive years. Even with the present brief open season, the reseeding of grounds may not be completed in 1 year. Because of the scarcity of oysters, the pearl grounds were closed during the year of 1948. The beneficial effects of the flexibility of administrative control are obvious, for they protect the natural resource from being completely wiped out by excessive fishing; the industry suffers, however, from such irregularity and uncertainty.

PRESENT CONDITIONS OF PEARL FISHERY

1. Location of pearl oyster banks

Pearl fishing in Venezuela has lost the glamour and adventure it had in former days, but under intelligent management by the government, has become a better established occupation which provides livelihood to a large number of people.

The pearl oyster grounds around the Margarita, Cubagua, and Coché Islands have not been adequately surveyed, and therefore the total area occupied by pearl oyster banks and the density of their population have not been determined. The location of pearl oyster is, however, well known to the fishermen. Most of the pearl beds are found in a canal between the Peninsula de Araya and the southern shore of the Margarita Island, in depths varying from 2 to 11 fathoms. Few grounds are located along the northern and eastern shores of Margarita. Each ground is known by the special name given in table 2. Central points of the grounds determined by Captain José M. Mosqueira (1943) are plotted on a sketch map reproduced in figure 1. Inquiries made in the office of Pearl Fisheries in Porlamar and among the divers revealed that the areas occupied by pearl banks greatly vary in size, some of them extending in length for more than 1 1/2 miles.

Pearl oysters are not confined to a single type of bottom. With the exception of mud, in which they are rarely found, they seem to thrive equally well on a great variety of substrata, such as gravel, stones, broken shells, and other materials firm enough to support the weight of the adult, and sufficiently hard and clean to permit the attachment of the larvae. The best bank, known as Noche y Día, is located along the east coast of Coché Island. Its bottom consists of small shells.

Table 2 — Pearl Oyster Grounds Near Margarita Island, Venezuela
(From José M.Mosqueira Manso, Ostras y Perlas
en las Costas Venezolanas, 1943)

No.	Name of Oyster Ground	Depth in Fathoms	Character of Bottom	Latitude	Longitude
1	Cardón del Tirano	7	Gravel	Lat. 11°-05'-48"N	Long. 63°-50'-12"W
2	Guarataro	7	Stones	Lat. 11°-04'-10"N	Long. 63°-49'-40"W
3	Bergantín	6	Stones	Lat. 10°-59'-08"N	Long. 63°-47'-00"W
4	Burrito	5	Stones	Lat. 10°-59'-00"N	Long. 63°-47'-35"W
5	Moreno	7	Gravel	Lat. 10°-58'-18"N	Long. 63°-48'-28"W
6	Farallón	4	Stones	Lat. 10°-58'-00"N	Long. 63°-48'-08"W
7	La Rama	5	Gravel	Lat. 10°-55'-58"N	Long. 63°-50'-45"W
8	Los Mosquitos	4	Gravel	Lat. 10°-52'-50"N	Long. 63°-53'-20"W
9	La Isleta	3	Sand and stones	Lat. 10°-52'-53"N	Long. 63°-55'-25"W
10	El Yaque	6	Sand and stones	Lat. 10°-52'-40"N	Long. 63°-57'-00"W
11	Gutiérrez	8	Mud and stones	Lat. 10°-49'-00"N	Long. 63°-52'-15"W
12	Rama Colorada	7	Sand and stones	Lat. 10°-47'-03"N	Long. 63°-50'-40"W
13	Los Medios	7	Sand and stones	Lat. 10°-45'-47"N	Long. 63°-50'-50"W
14	La Uva	5	Sand and stones	Lat. 10°-48'-12"N	Long. 63°-55'-22"W
15	Chivato	4	Stones	Lat. 10°-47'-18"N	Long. 63°-54'-03"W
16	Caleta del Coco	3	Sand and stones	Lat. 10°-46'-30"N	Long. 63°-53'-55"W
17	Piedras Negras	5	Sand and stones	Lat. 10°-45'-45"N	Long. 63°-53'-00"W
18	Cuspe	2	Stones	Lat. 10°-43'-30"N	Long. 63°-51'-48"W
19	Noche y Día	3	Small shells	Lat. 10°-50'-10"N	Long. 64°-08'-45"W
20	Los Barriles	3	Small shells	Lat. 10°-50'-00"N	Long. 64°-08'-00"W
21	Los Arenales	4	Sand and stones	Lat. 10°-48'-30"N	Long. 64°-07'-33"W
22	Yeirú	3	Gravel	Lat. 10°-48'-10"N	Long. 64°-09'-00"W
23	Cirial de Cubaqua	2	Gravel	Lat. 10°-47'-05"N	Long. 64°-12'-47"W
24	Cardón de Araya	11	Gravel	Lat. 10°-40'-00"N	Long. 64°-17'-00"W
25	Caracolito	4	Small shells	Lat. 10°-49'-28"N	Long. 64°-17'-55"W
26	Vapor	2	Sand and stones	Lat. 10°-38'-56"N	Long. 64°-18'-42"W
27	Cirial de Macanao	5	Stones	Lat. 11°-02'-30"N	Long. 64°-29'-10"W
28	El Tigre	5	Sand and stones	Lat. 11°-05'-16"N	Long. 64°-14'-33"W

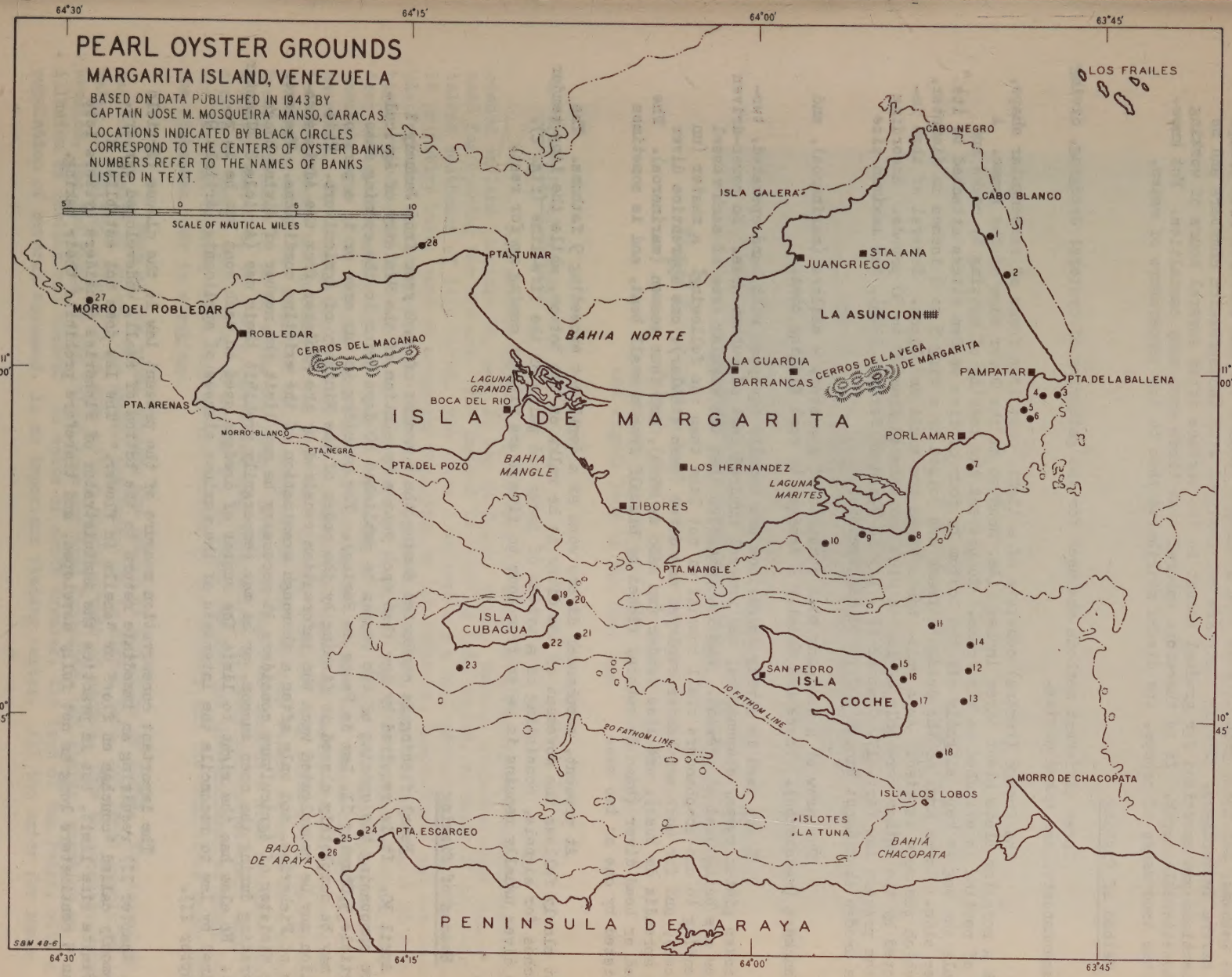

Figure 1. —— Sketch map showing the central points (black circles) of pearl oyster grounds around Margarita Island, based on survey made in 1943 by Captain José M. Mosqueira Manso.

Pearl oysters undoubtedly grow in water deeper than 11 fathoms, the maximum depths of the present exploitation. Several years ago, divers attempted to work at a depth of 14 fathoms, but these grounds were soon abandoned because the men suffered from cramps and severe hemorrhages. Diving boats are not equipped with decompression chambers and no precautions are exercised for gradual ascent to the surface after several hours of working at considerable depth. It is therefore natural that there were many casualties. Not knowing the true cause of cramps, the divers attributed them to low temperature of water.

2. Method of fishing

Three different methods are used for the gathering of oysters; dredging, diving in scaphanders, and naked diving.

The dredge (rastra) consists of a light, cast iron frame of rectangular shape, with a scraping plate about three inches wide, mounted at the lower edge of the frame. A bag of netting is attached to the frame. To prevent the tearing of netting by rocks and corals the bag is kept slightly off the bottom by four or five wooden sticks attached to its lower side. Three arms of the dredge's frame are joined by a ring 5 to 6 inches in diameter, to which the rope is tied. As a rule, the dredges are small and light. Several of them inspected by the author were only 24 inches wide and weighed from 20 to 30 pounds. According to the present law (Art. 17, Chapter III, Ley de Pesca de Perlas, 1944), the maximum size of a dredge should not exceed 100 by 80 centimeters.

The crew of a dredging boat consists of a master, 4 sailors (marineros), and 2 shuckers (rancheros). There are usually 2 dredges to each fishing boat.

Boats used in diving operations are usually equipped with hand-operated, two-cylinder piston pumps, scaphanders, and several hundred feet of rubber hose. No power-driven pumps are being used at present. The law specifies that the working crew of each vessel intending to use scaphanders shall consist of not less than the following: a master (un patron), and for each scaphander employed one diver (buzo titular), one apprentice diver (un aprendiz de buzo), one line tender (un cabo de vida), and four seamen (marineros). The naked or head diver (buzo de cabeza) fishes by himself from a small boat, and is sometimes assisted by one or two men.

At present, scaphander divers work at a depth not exceeding 9 fathoms. The boat slowly follows the movement of the diver as he walks on the bottom, while the line tender watches for signals, consisting of a system of jerks and pulls on the life-line (fig. 2). The diver usually remains in water from four to five hours without coming up for rest.

3. Season of fishing

Pearl fishing is conducted during the 4 months of each year from January 1 to April 30. It is required by law that each year a Resolution of the Ministry of Agriculture announcing the opening of the season be published 60 days prior to the opening date (Article 5, Chapter II, Ley de Pesca de Perlas). The pearling in any area or in a part of it may be completely closed to fishing by the order of the Ministry of Agriculture. This action may be promulgated upon the information received by the Minister from the Administrator of Fisheries, and only after a thorough examination of the existing conditions. Whenever the Minister of Agriculture considers it necessary he may limit the number of diving boats operating during the open season, or he may temporarily prohibit their use (Article 8, Chapter II). He also has the right to limit the number of dredges used on each boat but he is required by law to reconcile the interests of the various classes of applicants (Article 9, Chapter II).

The important conservation measure of the present law is the clause (Article 10, Chapter II) requiring an immediate return to the bottom of small, undeveloped oysters, commonly called "conchas en flor" or "shells in flower." The law does not establish a definite size limit, but in practice the Administrator of Fisheries considers oysters less than 5 centimeters long as not fully developed, and therefore prohibits their taking.

Figure 2. — Diving boat working in waters around Margarita Island. Notice life line tender standing on stern and holding air hose in the right hand and signal line in the left one.

4. Shucking of oysters

All oysters gathered by divers, or taken by dredgers, are brought ashore and opened on land (Article 10, par. 1, Ley de Pesca, 1944). Several well-sheltered places are used for opening the oysters. The largest is found on Isla Caribe, an uninhabited, rocky island southeast of Isla Coché. The place I visited was a well-protected cove. There were 18 primitive huts, used as temporary dwellings by the fishermen (rancheros), and one concrete platform for salting and drying the fish. Large shell heaps, some of them nearly 20 feet high, represented the results of many years of pearling (fig. 3). In places, there were deep holes or trenches in the accumulated shell material. Those were made by women and children who come after the men have finished opening the oysters and search through the discarded material. It is said that in this way a substantial number of pearls are being recovered. The shell heaps and grounds of the cove were greatly infested with black flies, and at the time of my visit the stench of decomposing oyster meat was very strong in spite of a fresh breeze of about 25 or 30 miles per hour. It was difficult to imagine a more desolate spot than the shores of this cove, where the many generations of fishermen opened their catch in search of pearls which later on served for no other purpose but the adornment of human beings. The contrast between the beauty of the product of the fishery and the conditions under which the fishermen work is striking.

Some of the pearl oysters are opened at San Pedro de Coché. The island is entirely devoid of water. The annual precipitation is almost zero, and local supply of water is wanting. The soil is dry, with a sparse growth of cactus. Due to excessive wind erosion, the red rocks of the island have acquired fantastic, odd shapes, creating an illusion of castles and towers. In spite of acute dryness, the town of San Pedro, with a population of several thousand, is an important fishing center. All the water for human

Figure 3. —— Accumulation of pearl oyster shells at the place where oysters are shucked on the Isla Caribe.

consumption is brought here by barge from the mainland. The effect of lack of water is particularly noticeable on the few domestic animals, - dogs, cats, and goats, which show obvious symptoms of severe dehydration. The Venezuelan Government is studying the possibility of laying a pipe across the ocean floor to supply the island with fresh water from the mainland. It is evident that a successful solution of water supply problem would be of enormous benefit to the progress of this community, and should open an era of prosperity to this small island.

Pearl oysters are edible and local fishermen use them in preparing their simple meals. Although it lacks the flavor and soft consistency of the edible oysters, the meat of a pearl oyster is quite palatable, and when cooked in boiled water has a pleasant taste. A vast supply of this wholesome food, which is now being wasted, can be utilized by establishing a processing plant on one of the islands, or in Porlamar. It is also suggested that a chemical study be made of pearl oyster meat as a possible source of vitamins that may be extracted from it.

5. Division of the proceeds

With the exception of naked divers, who usually work independently and make personal arrangements with their helpers, fishermen engaged in the pearl fishery operate on shares. A rather complex method of dividing the proceeds of the catch is governed by local tradition and customs. For a diving boat, the following scheme is customarily used: 50 percent of the money realized from the sale of pearls goes to the "empresario," i.e., the person who owns or outfits the boat; of this amount, the empresario pays one-half of the license fee and gives one-third of the balance to the diver. The rest is his. The remaining 50 percent is divided among the crew, in the following manner: first, the cost of food and half of the license fee are deducted; then the balance is divided into 14 shares, of which 6 shares are paid to the diver, and 8 shares are equally divided among the crew. The latter distribution may be slightly modified by special agreements.

In case of a dredging boat, the division is different: 1 1/2 shares go to the owner of the boat; 4 shares to the owner of the dredges (2 for each dredge); 1 1/2 shares to the master (patron) who is responsible for selecting and finding the oyster grounds; 4 shares to the 4 sailors (1 to each); and 2 shares to the 2 shuckers or rancheros (1 to each).

6. Selling of pearls

Immediately after they are collected the pearls are sold in the town of Porlamar on Margarita Island, which is the principal local market. During the fishing season, several licensed buyers open their offices here in which they appraise, sort, and buy pearls in lots brought by the fishermen (fig. 4). Some pearls, however, are sold directly to the tourists and visitors to Porlamar. As a matter of fact, one can hardly walk half a block in the town without being stopped by a pedlar who offers to sell a pearl (fig. 5). Taking advantage of the general ignorance of the public of the correct value of pearls, the prices asked are sometimes higher than one would pay in a legitimate jeweler's store in New York or in London. Those who know how to evaluate pearls may acquire them, however, at a very reasonable price. There is also a certain sentimental value to a visitor in Porlamar in buying a pearl as a souvenir directly from a fisherman, and in the place where the pearls are produced.

The wholesale buyers are required to obtain special license before they are allowed to open their business. The office of the buyer usually consists of a small room with a table covered with smooth woolen cloth, scales for weighing the pearls, and a set of sieves to sort them according to their size. One or two assistants, usually girls, help in sorting out the pearls.

In the season of 1948, there were 9 licensed buyers operating in Porlamar, only one of them from New York.

Figure 4. — Office of a wholesale buyer of pearls in Porlamar.

Figure 5. —— Common street scene in Porlamar; pedlar trying to sell pearls to visitors from Caracas. Because of sentimental value of a pearl acquired by a tourist directly from a fisherman the price asked is usually very high.

The pearls brought to the buyer's office by a group of fishermen are usually carried in a handkerchief or in a piece of cloth which is untied, and the lot is spread on the table. The best pearls are picked out first and set aside. Using a small and shallow silver scooper, the buyer puts the remaining pearls in a set of copper cups, three to four inches (7 to 10 cm.) in diameter with perforated discs fitting to the bottom of each cup. A complete set usually consists of 60 discs with holes varying from 1 to 6.5 mm. in diameter, and numbered from 1 to 60. The largest holes (No. 60 sieve) would retain the pearls of more than eight grains (about 2 1/2 carats). For preliminary sorting, the buyers use only three or four sieves, preferably the Nos. 27, 18, 12 and 10. If the buyer is satisfied with the preliminary inspection, he weighs separately the pearls of different sizes and quotes his price. In April 1948, one of the buyers was paying an average of about three bolivars per carat for fairly good pearls—this, of course, did not include pearls of unusual size and quality, nor the baroque pearls. The price of the latter was only 13 cents per carat. If the fishermen think that the price quoted is too low, they visit other buyers until they receive an acceptable offer. The buyers work independently of each other and there is apparently no collusion among them; although they are, of course, well informed about the prices and demands of the principal markets in India, London, and New York and consequently there is but little difference in their quotations.

If the price offered by private buyers is not acceptable to the fishermen, they can turn over their lots to the Administrator of Fisheries at Porlamar for official appraisal and disposal of the pearls through the Government Bank (Banco Agricola y Pecuario). The bank pays the value determined by the official appraisers (Pignoradores oficiales) minus 10 percent commission. Upon completion of the transaction, the pearls become government property and may be sold by the bank when market conditions are favorable, but the fishermen retain right to claim them back within 30 days. The stabilization of prices by the government is obvious benefit to pearl fishermen and protects their interest. This system, authorized by law of 1944, comes under a general scope of activities of the bank in supporting and developing agriculture, stock-raising, and fisheries (see Articles 14 and 46, Reforma Parcial de la Ley Del Banco Agricola y Pecuario IX - 4, p. 726-773 IX - 4 p. 726-773, Compilación Legislativa de Venezuela, 1944). The bank has a working capital of 60 millions bolivars.

In 1947, the bank advanced a credit to the fishermen in the amount of 72,100 bolivars for outfitting of boats and purchase of equipment, and purchased 831,434 bolivars' worth of pearls.

The method of appraisal used by government appraisers is essentially the same as that used by private buyers (fig. 6). The appraisers are appointed each year by the government for a four-month period, and work only during the duration of the pearling season, from January to the end of April.

7. Market for pearls

Only a small number of pearls are sold locally to visitors and tourists; the bulk is exported to India, China, and England. Relatively small number of pearls, and only of the highest quality, are distributed in the United States through the wholesalers in New York.

Market requirements in each of these countries are very specific. For instance, New York demands white pearls of highest lustre. Pink pearls, which are predominant in Venezuelan waters, are more in demand in Europe, while India and China import large quantities of seed pearls. At present the trade in pearls is suffering from generally unstable conditions in the world markets, and restrictions imposed by various countries on the export of their currency. India still remains the largest pearl market of the world. Contrary to one's expectation, however, this country buys not the largest or best pearls to adorn the dresses of her fabulously rich maharajahs, but imports vast quantities of seed pearls of inferior quality. Most of these pearls are consumed internally in an entirely unjustifiable belief that they produce a stimulating and generally beneficial effect on the human organism.

It is of interest that customers in India prefer round seed pearls and are willing to pay higher prices for them because of their naive faith that the medicinal effect of round pearls is better than that of irregularly shaped seed. Large quantities of minute seed pearls are also used in India for "treatment" of children's eyes. Every day one or two

Figure 6. — Official appraiser of pearls in Porlamar.

seeds are placed, for several minutes, under the lids of a baby in the belief that this will make his eyes darker and shiny. One of the buyers in Porlamar told me that about half of the volume of his business in India has been selling seed pearls for this purpose.

Pearls, purchased by a wholesale buyer, must be very carefully sorted before they are offered to various dealers or are shipped to different countries. From 15 to 20 sortings are sometimes required before the original lot purchased from the fishermen is divided according to various sizes, shapes, color, and other grades recognized by trade. Sorting is usually done by the girls, who assist the buyer and work under his immediate supervision. When the sorting is completed, the pearls are poured in small, cotton bags, or are wrapped in brown paper and stored in boxes.

For export, the pearls are classified according to their quality as: First quality (De Vista), round (redondas), baroque (barruecas), and seed (mostacilla). As can be seen from table 3, seed pearls comprise the largest part of the total quantity exported, while the greatest monetary return is derived from baroques.

Some of the dealers ship their stock to India for matching and drilling and, after the pearls are made into necklaces and other articles, import them to New York. This is done because of much lower prices for this type of work in India than in the United States or Europe.

Pearls exported from Venezuela must be accompanied by a certificate issued by the Minister of Agriculture or the Administrator of Fisheries ascertaining their legitimate origin. This certificate must be submitted to the custom officials (Article 19, Chapter IV, Ley de Pesca de Perlas) to clear the shipment through the Custom House.

The importation and trade in artificial and cultured pearls is prohibited by law (Article 21, Chapter IV, Ley de Pesca de Perlas).

Table 3 — Export of Various Classes of Pearls in 1946

Grade of Pearls	Quantity in Carats	Value in Bolivars
Seed (Mostacilla)	812,974	259,297
Baroque (Barruecas)	595,809	823,919
Round (Redondas)	132,225	245,508
First Quality (De Vista)	40,491	381,975
All grades	1,581,199	1,710,699

8. Economic importance of pearl fishery

Economic importance of the pearl fishery may be estimated by comparing the total value of pearls obtained annually with the value of all other fishery products for the same years. As can be seen from table 4, during the last three years, 1945 to 1947, the relative value of the pearl fishery gradually increased from 6.8 to 14.1 percent of the total value of all fisheries.

Table 4 — Production and Value of Fishes and Pearls in Venezuela from 1945 to 1947

	Fishes		Pearls		
Year	Yield in thousands kilos	Value in thousands B's.	Yield in thousands carats	Value in B's.	Percent of value
1945	28,442	15,441	1,400	1,050	6.8
1946	36,509	21,945	1,282	1,666	7.6
1947	40,862	29,485	1,785	4,165	14.1

In comparison with other products of export, such as oil and minerals, the pearl industry is small and insignificant, but it is quite important in the economic life of the State of Nueva Esparto where it provides substantial income to several hundred fishermen. According to the official data of the Section of Fisheries (Sección de Pesqueria, Dirección de Economiica Agricola, Minesterio de Agricultura y Cría, 1948), the following number of licenses were issued during the fishing season of 1947 (table 5).

Table 5 —— Number of Licenses issued in 1947 to Pearl Fishermen, Polarmar

Months	Scaphanders	Dredgers	Naked divers
February-March	20	364	1
March-April	35	468	0
April-May	28	405	0

During the same period, the total number of workers engaged in pearling was as follows:

February-March 2,774

March-April 3,661

April-May 3,143

Since the licenses are issued only for each month, we may conclude that the average number of persons employed by the pearl fishing industry is about 3,000.

Dividing the total value of pearls obtained in 1947 over this number of people, one can arrive at the figure of 1,388 bolivars as an estimated average income per person derived from pearling. The actual figures of income, of course, greatly differ from an average because of the unequal division of proceeds, as has been described above. Official statistics show that an average annual earning per boat engaged in pearling increased from 3,777 bolivars in 1945 to 12,620 bolivars in 1947. The increase was primarily due to the increase in price of pearls, from 0.75 bolivar per carat to an average of 2.50 per carat in 1947. The increase in the production of pearls from 1946 to 1947 was, however, only 43.9 percent.

In 1948, only 49 divers were engaged in the pearl fishery on Margarita Island. Of this number, 15 were "empresarios," i.e., those who were primarily concerned with the outfitting of diving boats rather than with diving. According to information received from the Porlamar office of the Sección de Pesqueria, 145 divers were working on Margarita Island in 1918. The decline in the number of divers became noticeable shortly after 1921 and 1922, the years of the best pearling seasons.

Most of the divers at present are middle aged persons, while the men of the younger generation are reluctant to become professional divers. In an attempt to overcome this difficulty, the Government established a school of divers (Chapter IX, Ley de Pesca de Perlas), but so far the institution has not been functioning because of the lack of applicants. If this trend continues, the scarcity of experienced divers may become so serious that it may lead to a complete abandonment of scaphander diving and more intensive development of dredging.

The occurrence of frequent interruptions in pearl fishing is one of the greatest handicaps of pearl industry in Venezuela. Attempts to stabilize the fishery by limiting the duration of the fishery season have not been completely successful even when the open season was reduced from 6 to 4 months only. It is true that under this system it was possible to carry out pearling operations for 4 consecutive years (see table 1, from 1945 to 1948, inclusive) but the oyster population was so reduced that during the present year (1949) the grounds were closed again. The present pearl fishery laws (Article 6, Ley de Pesca de Perlas)

define a "zone" or pearl oyster ground suitable for exploitation when a sample of 1,000 kilograms (2,204 lbs.) of oysters yield more than one gram (5 carats) of pearls for each 50 kilograms of oysters. Thus, a minimum pearl production is that of 90 carats per short ton of live oysters. The law is based exclusively on the content of pearls in the oysters, but not on the abundance of oysters on the bottom. From the point of view of management of the pearl resource, the density of the oyster population is fully as important as the number of pearls per oyster.

No detailed biological data are available at present concerning the abundance of oysters on different grounds and their rate of growth. Since these data would be of great value for the development of the oyster resources, I hope that eventually the necessary observations will be made by the government. The data on the fluctuations of the yield of pearls per sack of oysters in different years are, however, available (table 6).

Table 6 — Yield of Pearls Per Sack of Oysters

Item	1945	1946	1947
Sacks of oysters . . .	242,572	330,034	279,471
Carats of pearls . . .	1,451,214	1,032,730	1,284,858
Carats per sack . . .	5.70	3.12	4.60

Each sack contains from 35 to 45 kilograms of oysters. Since there are from 25 to 30 oysters to each kilogram, or from 875 to 1,350 oysters per sack, and the average yield (for three years, 1945-47) is 4.5 carats per sack, we may conclude that one should expect to open from 200 to 300 oysters to find 1 carat of pearls.

In recent years, the greatest portion of the oyster catch has been obtained by dredges (table 7). This, however, was not true in the previous years. Thus, during the season of 1939-1940 the total yield of pearls was almost equally divided between the dredges and scaphanders. Lopez (1940) states that during this year the scaphander divers obtained 496,400 carats, while the dredgers contributed 456,800 carats of pearls. Unfortunately, the number of sacks of oysters gathered by each group is not given in the paper from which these figures are quoted. It is, however, interesting that the present yield of pearls in the oysters obtained by divers is almost twice the yield in oysters gathered by dredgers. This probably was not the case in previous years.

The present relatively higher yield obtained by divers may be purely accidental, or it may be attributed to their ability to select better stock. The problem requires further study.

BIOLOGY AND CONSERVATION OF PEARL OYSTERS

Knowledge of the biology of the pearl oyster is essential for the effective conservation and exploitation of the species. Unfortunately, biological data concerning the time of spawning, setting, and growth of Venezuelan pearl oysters are scarce. José M. Mosqueira Manso, who for several years observed the oyster population around Margarita Island, states (1943, p. 36) that spawning of oysters in these waters begins at the end of April and terminates during the last days of August. According to Mosqueira (p. 41), about 10 percent of the pearl oysters around Margarita Island spawn by the middle of May. The percentage of spawning mollusks increases to 20 by the middle of June, and to 55 by the middle of July. About 5 percent of the oysters may be found spawning in September. During

Table 7 — Catch of Pearl Oysters (in sacks) by Gear and the Yield of Pearls in Carats

Type of Gear Used	1945 Sacks of Oysters	1945 Carats of Pearls	1946 Sacks of Oysters	1946 Carats of Pearls
Dredge	236,851	1,384,462	330,034	877,427
Scaphander	5,721	66,752	29,003	155,003
Skin divers . . .	—	—	100	300
Percentage taken by scaphander divers	2.4	4.6	8.8	15.0

the latter month the oysters that have already spawned are usually in poor condition. Detailed observations on setting are not available. It is known that young oysters would set on any hard object with a clean surface. Growth is apparently rapid. Fishermen and administrative officers concerned with the pearl fisheries at Porlamar maintain that within 6 months young pearl oysters are already fully developed and may be fished.

Mosqueira believes that growth of pearls is also rapid, for about 85 percent of all the pearls taken in one season are obtained from young oysters. He thinks the oyster discards the old pearls by ejecting them from the mantle cavity. This interesting point deserves further study as it is very important, from the point of view of management, to know more definitely how long the oysters retain the pearls.

Frequent closings of grounds constitute serious handicaps for the development of the industry on a more sound basis. At present, pearl fishermen do not know until 60 days prior to the opening date of the season whether the grounds will be open to pearling. Consequently, pearl fishing cannot be depended upon for a livelihood and becomes a secondary occupation. Likewise, it is difficult to expect that anyone will invest money in improvements of boats and gear without any assurance that he will have a chance to use them.

SUGGESTED PLAN OF BIOLOGICAL STUDIES

Present law (Article 27, Chapter VII, Ley de Pesca de Perlas) authorizes the conduct of investigations to determine the possibility of enlarging existing oyster grounds and establishing new ones. Particular mention is made of the required participation in this work of pearl fishermen who are obligated to contribute for this purpose 25 percent of the shells. Inasmuch as no systematic work of this type is being conducted at present, it is my suggestion that careful consideration be given to the organization of such biological and ecological studies as are needed for the development of new pearl oyster grounds. The present system is essentially that of an exploitation of a natural resource, without any attempt to apply oyster cultural methods. We know, from the experience in cultivation of edible and pearl oysters in other countries, that an oyster population can be materially increased by oyster farming technique. It is, therefore, reasonable to expect that the same beneficial results may be obtained in Venezuelan waters. As a first step in this direction, it is necessary to obtain more detailed knowledge and understanding of local biological factors.

First, more precise information is needed of the time and intensity of spawning. Experience with other species of oysters shows that during the reproductive season there are several periods of more intense spawning. Factors controlling the occurrence of these periods should be carefully determined in order to be able to predict time of spawning with a reasonable degree of accuracy. Likewise, the attachment of young oysters (setting),

which may continue throughout the summer, varies in intensity and may have several pronounced maxima. The occurrence of these periods is of great practical significance, because the production of seed can be materially increased by providing suitable clutch at the right time and in the right places.

The study of setting may be easily undertaken by a competent marine biologist by using wire bag collectors (small bags made of chicken wire, filled with clean oyster shells) placed at various stations or suspended at different levels from floats anchored in selected locations. Each bag should be replaced at least once a week and its contents examined. In this way the intensity of setting, its exact time, and the optimum zone of setting at various depths can be accurately established.

If such experiments are successful and a sufficient number of young pearl oysters are obtained on collectors, they can be transplanted to different experimental grounds to determine the rate of growth of oysters and to study the factors controlling the production of pearls.

The formation of pearls has been the subject of many investigations, and various factors responsible for the development of a pearl, such as mechanical irritation or presence of parasites, are more or less understood. We do not know, however, why oysters on certain grounds abound in pearls, while on others the pearls are almost lacking. For instance, there are many places in Venezuelan waters which abound in pearl oysters, but the latter contain no pearls. Detailed ecological studies are necessary for the understanding of local factors which favor the formation of pearls on certain grounds.

Critical study of ecological factors responsible for the production of pearls may lead to considerable improvement in the quality of natural pearls and to the increase in their abundance. The aim of the proposed plan should be the finding of practical methods to increase the population of pearl oysters by facilitating their natural propagation, and to encourage the production of pearls by selecting the grounds most suitable for this purpose. The application of such a method may greatly increase the yield of the fishery and decrease the fishing effort because oysters will be taken from more densely populated areas and only from the grounds known to be highly productive in pearls.

In planning this type of work, it is essential that certain grounds be closed to the fishery and set aside for experimental purposes to determine the rate of growth of young oysters, to carry out experiments with transplantation of seed oysters, and to determine their mortality rate. Studies of the rate of development of pearls, and of the percentage of oysters containing them, as well as the investigation of other factors, such as diseases, effects of parasites, and attacks of various enemies, can be conducted simultaneously with the observations of oyster biology. Experimental grounds should not be large, so that their establishment would not materially interfere with fishing operations. It is, however, important that the selected grounds be well patrolled to prevent unauthorized fishing, which may ruin the experiments.

Under the present system of management, and barring unforeseen circumstances, the pearl oyster fishery around Margarita Island is expected to continue with occasional interruptions without danger of serious depletion. But as long as the fishery is based on the exploitation of natural oyster grounds and depends entirely on natural repopulation of oyster banks, it cannot keep pace with the increased intensity of fishing. In order to minimize the effects of frequent interruptions, caused by insufficient supplies of oysters, and to assure greater stability of the fishery, the present system of adjustment of fishery efforts to the existing supply should be gradually changed to a system of cultivation of pearl oysters, or oyster farming. Before such steps are undertaken by the Administrator of Fisheries, several important phases of pearl oyster biology and ecology, discussed above, must be elucidated by competent biological investigations. The program of such studies may be briefly outlined as follows:

1. Survey of the principal pearl oyster grounds. Determination of the areas and density of oyster population of each zone.

    a. Ecological characteristics - depth, character of bottom and sea water, currents, organisms associated with pearl oyster, and enemies of pearl oyster.

2. Survey of non-productive or barren grounds with the view of determining their suitability for establishing new oyster beds by planting young pearl oysters.

3. Observation on time and intensity of spawning and setting on selected grounds around Margarita Island.

a. Weekly observations at several selected stations. Spawning may be determined by examining the oysters and by taking plankton samples and identifying the larvae.

b. Study of setting by placing a series of collectors (wire bags filled with shells or other type) which are replaced at least once a week and examined in the laboratory.

c. Additional observations on the intensity and rate of setting on shells, rocks, and other bottom material.

4. Biological studies on the rate of growth of oysters.

a. Determination of the exact time of their maturity and of the sex ratio.

5. Studies of the ecological factors responsible for the formation of pearls. Effect of parasites, commensals, and of mechanical irritation. (Elucidation of this point will be very valuable in governing the selection of new pearl grounds.)

6. Studies of the diseases and of the life histories of parasites and enemies of the pearl oyster.

7. Technological studies for developing methods of utilizing pearl oyster meats.

The program may be undertaken as a whole, or in part. Its execution requires the establishment of a marine laboratory in Porlamar, continuous use of a motor boat (about 42-48 ft. long) equipped with dredges, and occasional services of scaphander divers. Personnel needed for carrying out the program should consist of one marine biologist, trained in shellfishery work, one assistant marine biologist, and two laboratory aides.

The organization of the outlined program should be considered as a long-term project, lasting for at least 5 years.

The present system of administrative management of the pearl oyster resources of Venezuela is based on sound principles of conservation. It consists of controlling the intensity of fishing in relation to the available supply of adult oysters. Practical application of these administrative methods is both effective in conserving the natural resources and fair to the fishermen. Guided by his long experience and understanding of the conditions existing on pearl oyster grounds, the present administrator of the pearl fishery is able to manage the fishery in such a way as to reconcile the interests of local pearl fishermen and the needs of conservation. Barring unforeseen circumstances, the yield of the fishery, with minor fluctuations and occasional interruptions, may be expected to continue for years.

Expansion and development of the fishery, by using more effective methods of harvesting, and by increasing the abundance of the pearl oyster by planting, may be attained only by gradual adaptation of the methods of oyster farming. The initiation of this program should be based on extensive biological and technical studies which, in general, are discussed in this report.

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